7.1 Climate and Meteorology

D. J. Hoitink

Meteorological measurements are taken to support Hanford Site emergency preparedness and response, operations, and atmospheric dispersion calculations for dose assessments (Appendix D, Tables D.5 through D.9). Support is provided through weather forecasting and maintenance and distribution of climatological data. Forecasting is provided to help manage weather-dependent operations. Climatological data are provided to help plan weather-dependent activities and are used as a resource to assess the environmental effects of Hanford Site operations.

The Cascade Range to the west of Yakima greatly influences the climate of the Hanford Site. These mountains create a rain shadow effect and also serve as a source of cold air drainage, which significantly affects the wind regime.

The Hanford Meteorology Station is located on the 200 Areas plateau, where the prevailing wind direction is from the northwest during all months of the year. The secondary wind direction is from the southwest. Summaries of wind direction indicate that winds from the northwest quadrant occur most often during winter and summer. During spring and fall, the frequency of southwesterly winds increases, with a corresponding decrease in the northwesterly flow. Monthly average wind speeds are lowest during winter months, averaging 10 to 11 km/h (6 to 7 mph), and highest during summer, averaging 13 to 15 km/h (8 to 9 mph). Wind speeds that are well above average are usually associated with southwesterly winds. However, summertime drainage winds are generally northwesterly and frequently reach 50 km/h (30 mph). These winds are most prevalent over the northern portion of the site.

Atmospheric dispersion is a function of wind speed, wind duration and direction, atmospheric stability, and mixing depth. Dispersion conditions are generally good if winds are moderate to strong, the atmosphere is of neutral or unstable stratification, and there is a deep mixing layer. Good conditions associated with neutral and unstable stratification exist approximately 57% of the time during summer. Less-favorable conditions may occur when wind speed is light and the mixing layer is shallow. These conditions are most common during winter, when moderately to extremely stable stratification exists approximately 66% of the time. Occasionally, there are extended periods of poor dispersion conditions, primarily during winter, which are associated with stagnant air in stationary high-pressure systems.

7.1.1 Historical Information

Daily and monthly averages and extremes of temperature, dew point temperature, and relative humidity for 1945 through 1997 are reported in PNNL-11794. From 1945 through 1997, the record maximum temperature was 45ºC (113ºF) recorded in August 1961, and the record minimum temperature was -30.6ºC (-23ºF) in February 1950. Normal monthly average temperatures ranged from a low of -0.4ºC (31.3ºF) in January to a high of 24.6ºC (76.2ºF) in July. During winter, the highest monthly average temperature at the Hanford Meteorology Station was 6.9ºC (44.5ºF) in February 1991, and the record lowest was -11.1ºC (12.1ºF) in January 1950. During summer, the record maximum monthly average temperature was 27.9ºC (82.2ºF) in July 1985, and the record minimum was 17.2ºC (63.0ºF) in June 1953. The annual average relative humidity at the Hanford Meteorology Station was 54%. Humidity was highest during winter, averaging approximately 76%, and lowest during summer, averaging approximately 36%. Average annual precipitation at the Hanford Meteorology Station was 15.9 cm (6.26 in.). The wettest year on record, 1995, received 31 cm (12.30 in.) of precipitation; the driest, 1976, received 8 cm (2.99 in.). Most precipitation occurs during winter, with more than half of the annual amount occurring from November through February. The snowiest winter on record, 1992-1993, received 142.5 cm (56.1 in.) of snow.

7.1.2 Results of 1997 Monitoring

1997 was warmer than normal with nearly normal precipitation. The average temperature for 1997 was 12.7ºC (54.8ºF), which was 0.8ºC (1.5ºF) above normal (11.8ºC [53.3ºF]). Nine months during 1997 were warmer than normal, and three months were cooler than normal. May had the highest positive departure, 2.1ºC (3.7ºF); June, at 0.7ºC (1.2ºF) below normal, had the largest negative departure.

Precipitation for 1997 totaled 16.2 cm (6.39 in.), 102% of normal (15.9 cm [6.26 in.]), with 19.8 cm (7.8 in.) of snow (compared to an annual normal snowfall of 35.1 cm [13.8 in.]).

The average wind speed for 1997 was 12.7 km/h (7.9 mph), which was 0.3 km/h (0.2 mph) above normal. The peak gust for the year was 116 km/h (72 mph) on October 30. This was the highest gust ever recorded in October, and the fourth highest wind gust ever recorded at the Hanford Meteorology Station. Historically, the highest wind gust was 80 mph on January 11, 1972. Figure 7.1.1 shows the 1997 wind roses (diagrams showing direction and frequencies of wind) measured at a height of 10 m (32.8 ft) for the 29 meteorological monitoring stations on and around the Hanford Site.

Table 7.1.1 provides monthly climatological data from the Hanford Meteorology Station for 1997.

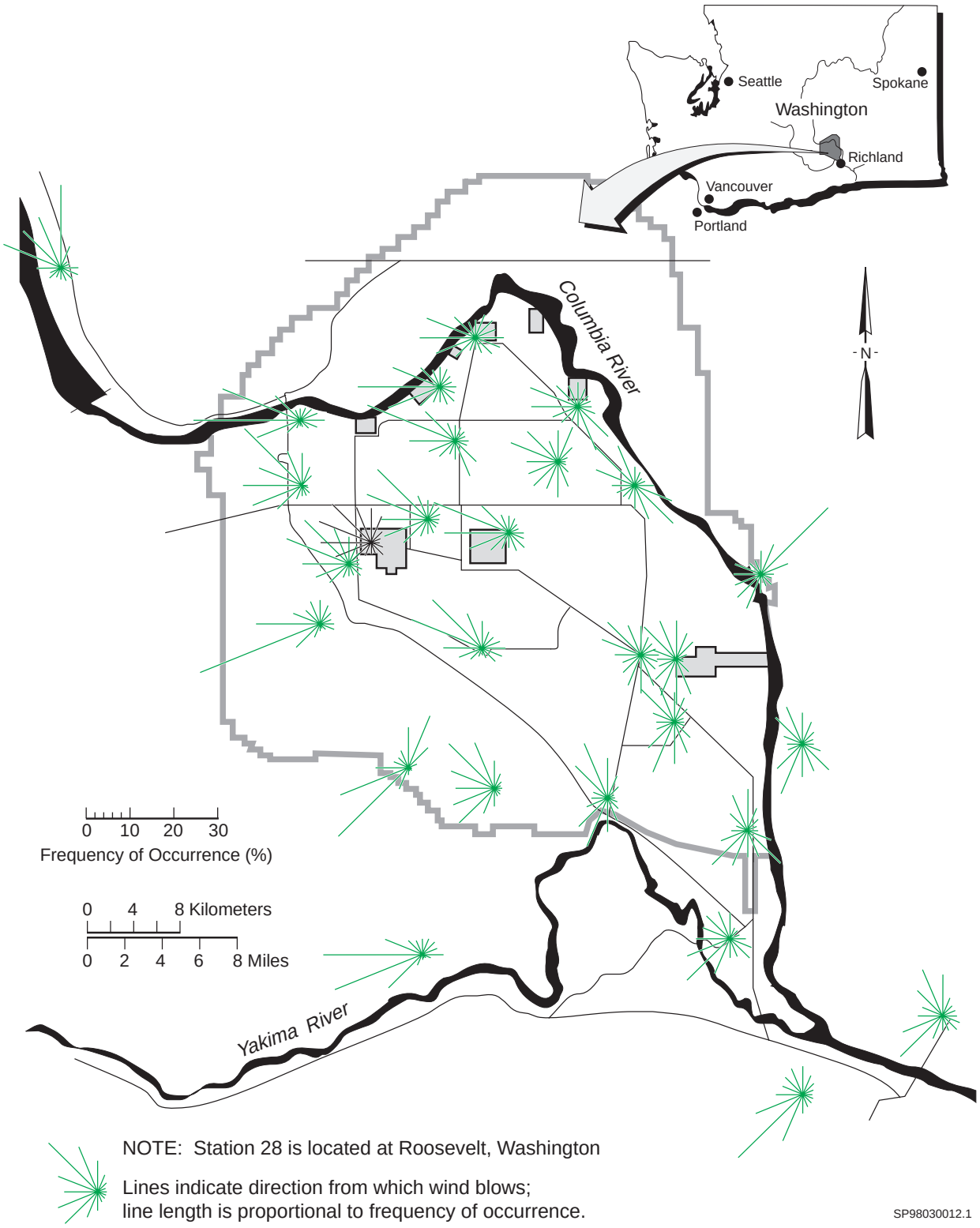

Figure 7.1.1. Hanford Meteorological Monitoring Network Wind Roses (measured at a height of 10 m [32.8 ft]), 1997. Individual lines indicate direction from which wind blows. Length of line is proportional to frequency of occurrences from a particular direction.

Table 7.1.1. Monthly Climatological Data from the Hanford Meteorology Station, 1997

Hanford Meteorology Station, 40 km (25 mi) northwest of Richland, Washington,
latitude 46° 34'N, longitude 119° 35'W, elevation 223 m (733 ft)

Month	Temperatures, °C								Precipitation (cm)				Relative Humidity (%)		15-m Wind[a]				
	Averages				Extremes						Snowfall						Peak Gusts		
	Daily Maximum	Daily Minimum	Monthly	Departure[b]	Highest	Date	Lowest	Date	Total	Departure[b]	Total	Departure[b]	Average	Departure[b]	Average Speed, km/h	Departure[b]	Speed, km/h	Direction	Date
J	5.2	-3.4	0.9	+1.3	13.9	2	-13.3	14	3.8	+1.8	4.6	-5.3	74.7	-1.7	10.6	+0.2	79	SSW	1
F	9.8	-0.7	4.6	+1.2	17.8	15	-6.7	5	0.6	-0.9	6.8	+1.7	67.5	-2.8	11.9	+0.3	68	W	19
M	14.7	2.4	8.6	+1.1	24.4	25	-2.2	14	1.8	+0.6	3.8	+3.0	55.2	-0.7	15.5	+2.1	95	WSW	30
A	18.2	3.9	11.0	-0.5	23.9	26	-3.9	6	0.8	-0.2	0	-T[c]	46.0	-1.2	14.6	+0.2	87	WSW	20
M	26.2	10.6	18.3	+2.1	34.4	13[d]	-1.1	2	0.8	-0.5	0	0	41.5	-1.2	13.2	-1.4	58	SW	31
J	27.9	12.7	20.3	-0.7	36.7	15	7.8	22[d]	1.2	+0.2	0	0	41.4	+2.6	14.5	-0.3	77	W	17
J	32.7	15.4	24.1	-0.5	38.3	21[d]	9.4	10	0.5	0	0	0	37.4	+3.9	13.5	-0.6	72	SW	9
A	34.2	16.9	25.6	+1.6	41.1	14[d]	11.1	29	0.2	-0.5	0	0	35.8	0	12.9	+0.2	89	WSW	26
S	26.8	11.9	19.3	+0.6	35.0	1	6.7	21	0.8	0	0	0	51.9	+9.2	13.0	+1.1	77	WSW	26
O	18.6	5.0	11.8	+0.2	25.0	17	-1.7	25	2.3	+1.4	0	-T	58.6	+3.4	13.4	+2.9	116	SW	30
N	11.1	1.3	6.2	+1.7	17.2	1	-5.0	13	2.6	+0.3	0	-4.6	77.8	+4.4	10.0	-0.3	53	S	28
D	5.4	-2.5	1.5	+1.8	15.6	16	-7.2	22	0.8	-1.8	4.6	-9.9	81.0	+0.7	8.9	-0.6	66	S	16
Y[e]	19.3	6.2	12.7	+0.8	41.1	Aug 14[d]	-13.3	Jan 14	16.2	+0.3	19.8	-15.1	55.6	+1.3	12.7	+0.3	116	SW	Oct 30

NOTE: See Table H.2, Conversion Table in "Helpful Information" for unit conversion information.

(a) Measured on a tower 15 m (50 ft) above the ground.

(b) Departure columns indicate positive or negative departure of meteorological parameters from 30-year (1961-1990) climatological normals.

(c) Trace.

(d) Latest of several occurrences.

(e) Yearly averages, extremes, and totals.